

**Type A Accident
Investigation Board Report
on the February 20, 1996,
Fall Fatality
at the
Radioactive Waste Management Complex
Transuranic Storage Area - Retrieval Enclosure
Idaho National Engineering Laboratory**



March 1996

**Office of Oversight
Environment, Safety and Health
U.S. Department of Energy**

This report is an independent product of the Type A Accident Investigation Board appointed by Tara O'Toole, M.D., M.P.H., Assistant Secretary for Environment, Safety and Health (EH-1).

The Board was appointed to perform a Type A Investigation of this accident and to prepare an investigation report in accordance with DOE Order 225.1, *Accident Investigations*.

The discussion of facts, as determined by the Board, and the views expressed in the report do not assume and are not intended to establish the existence of any duty at law on the part of the U.S. Government, its employees or agents, contractors, their employees or agents, or subcontractors at any tier, or any other party.

This report neither determines nor implies liability.

On February 22, 1996, I established a Type A Accident Investigation Board to investigate the fall at the Transuranic Storage Area-Retrieval Enclosure of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory that resulted in the fatality of a construction Project Engineer. The Board's responsibilities have been completed with respect to this investigation. The analysis, identification of direct, contributing, and root causes, and judgments of need reached during the investigation were performed in accordance with DOE Order 225.1, *Accident Investigations*. I accept the findings of the Board and authorize the release of this report for general distribution.

Tara O'Toole, M.D., M.P.H.
Assistant Secretary
Environment, Safety and Health

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ACRONYMS AND INITIALISMS

CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EH	DOE Office of Environment, Safety and Health
EM	DOE Office of Environmental Management
ES&H	Environment, Safety and Health
ID	DOE Idaho Operations Office
INEL	Idaho National Engineering Laboratory
LITCO	Lockheed Idaho Technologies Company
M&O	Management and Operating
OSHA	Occupational Safety and Health Administration
RWMC	Radioactive Waste Management Complex
TSA-RE	Transuranic Storage Area-Retrieval Enclosure

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PROLOGUE

OFFICE OF ENVIRONMENT, SAFETY AND HEALTH

INTERPRETATION OF SIGNIFICANCE

The fatality at the Idaho National Engineering Laboratory on February 20, 1996, resulted from failures of Department of Energy (DOE), contractor, and subcontractor management, and the accident victim. The subcontractor, the employer of the accident victim, had a poor record of serious safety deficiencies and had never accepted the higher levels of safety performance required by the Department's safe work ethic.

Although all the appropriate contractual and procedural requirements were in place, the subcontractor failed to implement them and continued to allow violations of Occupational Safety and Health Administration regulations invoked by DOE orders. These serious deficiencies were recognized by the prime contractor, which was instituting progressively stronger sanctions against the subcontractor. However, because of the subcontractor's recalcitrance and the imminent danger conditions represented by the subcontractor's frequent violations of fall protection requirements, more aggressive measures, such as contract cancellation, could have been taken earlier.

The prime contractor's oversight was narrowly focused on selective aspects of the subcontractor's safety performance and did not identify the subcontractor's failure to implement its own procedures, the medical surveillance program, or fall protection. Thus, the implications and frequency of imminent danger hazards were not fully appreciated. Departmental oversight focused on the subcontractor's performance and did not identify the gaps in the prime contractor's oversight focus. As a result, hazards were not identified and barriers were not in place to prevent the accident, which could have been avoided.

This fatality highlights the importance of a complete approach to safety that stresses individual and line management responsibility and accountability, implementation of requirements and procedures, and thorough and systematic oversight by contractor and Department line management. All levels of line management must be involved. Contractual requirements and procedures, implementation of these requirements, and line management oversight are all necessary to mitigate the dangers of hazards that arise immediately in the workplace. Particular attention must be paid to individual performance and what is happening in the workplace. Sound judgment, constant vigilance, and attention to detail are necessary to deal with hazards of immediate concern. When serious performance deficiencies are identified, there must be strong, aggressive action to mitigate the hazards and reestablish a safe working environment. Aggressive actions, up to and including swift removal of organizations that exhibit truculence toward safety, are appropriate and should be taken.

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EXECUTIVE SUMMARY

INTRODUCTION

A fatality was investigated in which a construction subcontractor fell from a temporary platform in the Transuranic Storage Area-Retrieval Enclosure (TSA-RE) (Building 636) of the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory (INEL). In conducting its investigation, the Accident Investigation Board used various analysis techniques, including event and causal factor analysis, barrier analysis, change analysis, and root cause analysis. The Board inspected and videotaped the accident site, reviewed events surrounding the accident, conducted extensive interviews and document reviews, and performed causation analyses to determine the factors that contributed to the accident, including any management system deficiencies. Relevant management systems and factors that could have contributed to the accident were evaluated in accordance with the Guiding Principles of Safety Management identified by the Secretary of Energy in an October 1994 letter to the Defense Nuclear Facilities Safety Board, and subsequently to Congress.

ACCIDENT DESCRIPTION

The accident occurred at approximately 11:20 a.m. on Tuesday, February 20, 1996, at the TSA-RE, when a construction subcontractor project engineer (Project Engineer), employed by Caddell Construction Company, Inc. (Caddell), fell approximately 17 feet from a temporary platform. [Caddell is a construction subcontractor to Lockheed Idaho Technologies Company (LITCO), the management and operating contractor for INEL.] The platform had been installed to catch falling tools and parts and to provide support for a transition piece to the ventilating system in the TSA-RE, but it was also used as a work platform for personnel activities when 100 percent fall protection was used. The Project Engineer was transported by helicopter to the Eastern Idaho Regional Medical Center in Idaho Falls, Idaho, where he died at 4:10 p.m. from severe head and neck injuries.

DIRECT AND ROOT CAUSES

The **direct cause** of the accident was the fall from an unprotected platform.

The **root causes** of the accident were (1) failure by Caddell to implement requirements and procedures that would have mitigated the hazards, and (2) failure by Caddell to effectively implement the Secretary's guiding principle mandating line management responsibility and accountability for safety performance.

CONCLUSIONS AND JUDGMENTS OF NEED

Conclusions of the Board and Judgments of Need as to managerial controls and safety measures necessary to prevent or mitigate the probability of a recurrence are summarized in Table ES-1. Investigative readiness is also discussed.

Table ES-1 Conclusions and Judgments of Need

CONCLUSIONS	JUDGMENTS OF NEED
<ul style="list-style-type: none"> ■ Comprehensive safety requirements exist, are contractually invoked, and are appropriate for the nature of TSA-RE construction work. 	None
<ul style="list-style-type: none"> ■ Caddell failed to follow procedures required by its contract and by its ES&H Program Plan, including: <ul style="list-style-type: none"> • Failure to adequately implement a medical surveillance program permitted an individual with medical restrictions, including not working at heights, to work in violation of those restrictions. • Caddell failed to adequately implement fall protection requirements contained in its ES&H Program Plan for the TSA-RE project, including enforcement of a three-tiered approach to fall protection. The third tier (choice of last resort) requires anchor points, lanyards, shock absorbers, and full-body harness. • Although the Project Engineer had a reputation for adhering to applicable safety regulations, on the day of the accident, he did not follow prescribed procedures. He was not wearing any fall protection equipment and did not obtain a direct reading dosimeter before entering the radiological control area. • The Project Engineer’s preexisting medical condition, which was the source of his medical restrictions, may have impaired his judgment and may have contributed to the accident. 	Caddell line management and safety personnel need to implement existing safety requirements and procedures.
<ul style="list-style-type: none"> ■ Caddell and LITCO did not fully implement the hazard inspection requirements of the TSA-RE contract and Caddell’s ES&H Program Plan, and therefore did not sufficiently identify or analyze hazards and institute protective measures necessary due to changing conditions. 	Caddell and LITCO need to ensure that an adequate hazards analysis is performed prior to changes in work tasks that affect the safety and health of personnel.
<ul style="list-style-type: none"> • A radiological control barrier discouraged access to the area, and made it difficult for line management and safety personnel to recognize and analyze safety hazards in the surrounding area, including hazards associated with the platform. 	LITCO needs to carefully evaluate, post, and control radiological control boundaries so that safety and management walkdowns are not discouraged, or access made unnecessarily restrictive.

Table ES-1 Conclusions and Judgments of Need (continued)

CONCLUSIONS	JUDGMENTS OF NEED
<ul style="list-style-type: none"> • Neither a Job Safety Analysis nor a Construction Safe Work Permit was completed for the transition piece installation and temporary platform construction in accordance with contractual requirements. • Caddell management at all levels, including the corporate office, was unresponsive to demands for improved safety performance for a significant portion of the construction project. • LITCO failed to assess Caddell’s compliance with all contractual ES&H obligations and thus did not recognize that the medical surveillance and fall protection programs were not being executed as described in the Caddell ES&H Program Plan. • Idaho Operations Office oversight focused almost exclusively on the performance of Caddell and its subtiers in the field. As a result, the Operations Office failed to recognize that LITCO was not assessing all aspects of Caddell’s ES&H contractual obligations. 	<p>LITCO and Idaho Operations Office oversight programs need to be better balanced between field verifications and assessments of all aspects of Caddell's ES&H program.</p>
<ul style="list-style-type: none"> ■ A temporary platform, used as a work surface for personnel activities when employing 100 percent fall protection, did not have guardrails and was left in place without barriers or other warning devices. • Caddell failed to post adequate warning signs and establish barriers to warn personnel that they were approaching within six feet of the edge of a fall hazard, as required by Occupational Safety and Health Administration regulations and Caddell's ES&H Program Plan. • LITCO failed to recognize that warning signs and barriers were not in place in the work area on top of the stack. 	<p>Caddell and LITCO need to ensure that safety personnel inspect changing work conditions for previously unidentified safety and health hazards, and implement protective measures.</p>

Table ES-1 Conclusions and Judgments of Need (continued)

CONCLUSIONS	JUDGMENTS OF NEED
<ul style="list-style-type: none"> ■ Although response by site personnel to the accident was good, Caddell’s and LITCO’s actions in the wake of the accident demonstrated little understanding of investigative readiness capabilities. • Caddell failed to provide the Board, in a timely manner, the Project Engineer’s employment, work restrictions and medical records. Caddell also failed to recognize the Board’s investigative needs before releasing the Project Engineer’s personal effects. • LITCO failed to develop an accident investigation readiness capability addressing evidence preservation, control, accountability, and chain of custody. 	<p>ID needs to develop contractual requirements and modify existing contractual requirements for accident investigation readiness capability to ensure timely responsiveness to the needs of future investigations, in accordance with DOE Order 225.1.</p>

**TYPE A ACCIDENT
INVESTIGATION BOARD REPORT
ON THE FEBRUARY 20, 1996,
FALL FATALITY
AT THE
RADIOACTIVE WASTE MANAGEMENT COMPLEX
TRANSURANIC STORAGE AREA - RETRIEVAL ENCLOSURE
IDAHO NATIONAL ENGINEERING LABORATORY**

1.0 INTRODUCTION

1.1 BACKGROUND

On February 20, 1996, at approximately 11:20 a.m., a construction subcontractor project engineer (Project Engineer) working at the Idaho National Engineering Laboratory (INEL) fell approximately 17 feet from a temporary platform. The platform was built to catch falling tools and parts and to provide support for a transition piece being installed as part of the ventilating system in the Transuranic Storage Area-Retrieval Enclosure (TSA-RE) (Building 636) at the Radioactive Waste Management Complex (RWMC). The Project Engineer was transported by helicopter to the Eastern Idaho Regional Medical Center in Idaho Falls, Idaho, where he died at 4:10 p.m. from severe head and neck injuries.

On February 22, 1996, Tara O'Toole, M.D., M.P.H., Assistant Secretary for Environment, Safety and Health, U.S. Department of Energy (DOE), appointed a Type A Accident Investigation Board to investigate the accident, in accordance with DOE Order 225.1, *Accident Investigations* (See Appendix A).

1.2 FACILITY DESCRIPTION

Contractor activities at INEL are managed by the DOE Idaho Operations Office (ID). The facility in which this accident occurred is under programmatic direction of the Office of Environmental Management (EM).

In October 1994, contractor activities at INEL were consolidated under a single management and operating (M&O) contract

A subcontractor project engineer died from a fall at the Idaho National Engineering Laboratory on February 20, 1996.

Contractor activities are consolidated under Lockheed Idaho Technologies Company (LITCO) and managed by the Idaho Operations Office.

awarded to Lockheed Idaho Technologies Company (LITCO),¹ which included member companies of Lockheed, RUST, Duke, Babcock and Wilcox, Parsons, and Coleman.

Since 1970, defense-generated transuranic waste has been received at the RWMC, placed on asphalt pads, and covered with soil. The plan was that these containers would all be retrieved within 20 years and shipped to the Waste Isolation Pilot Project near Carlsbad, New Mexico, which is the intended disposal site.

The TSA-RE structure is 97 percent completed and provides a weather-tight enclosure in which the waste can be retrieved year-round. The structure also helps to prevent the spread of any contamination that could be released from breached or deteriorated waste packages, or from a material handling accident during retrieval operations.

The transuranic waste stored at TSA-RE consists principally of stacked metal drums and fiberglass-reinforced plywood boxes covered with a vinyl-coated, geo-fabric tarpaulin (originally provided for weather protection), and then covered with approximately four feet of earth, except for the south end of the stack which has no earthen cover (see Exhibit 1-1).

1.3 SCOPE, CONDUCT, AND METHODOLOGY

The Board commenced its investigation on February 22, 1996, completed the investigation on March 18, 1996, and submitted its findings to the Assistant Secretary for Environment, Safety and Health on March 21, 1996.

The **scope** of the Board's investigation was to review and analyze the circumstances to determine the accident's causes. During the investigation, the Board inspected and videotaped the accident site, reviewed events surrounding the accident, conducted extensive interviews and document reviews, and performed causation analyses.

The **purposes** of this investigation were to determine the nature, extent, and causation of the event and any programmatic impact, and to assist in the improvement of policies and practices, with emphasis on safety management systems.

¹With the recent merger between Lockheed and Martin-Marietta, the operating company was renamed Lockheed-Martin Idaho Technologies. However, because official contractual documents have not been modified to reflect this change, LITCO is the acronym used to refer to the joint venture in this report.

The facility where the accident occurred is used to store transuranic waste in stacked drums and boxes.

The Accident Investigation Board was convened to determine why the accident happened and how similar accidents can be avoided in the future, with emphasis on safety management systems.

RADIOACTIVE WASTE MANAGEMENT COMPLEX

TSA RETRIEVAL
ENCLOSURE
BLDG 636
FEB. 20 1996

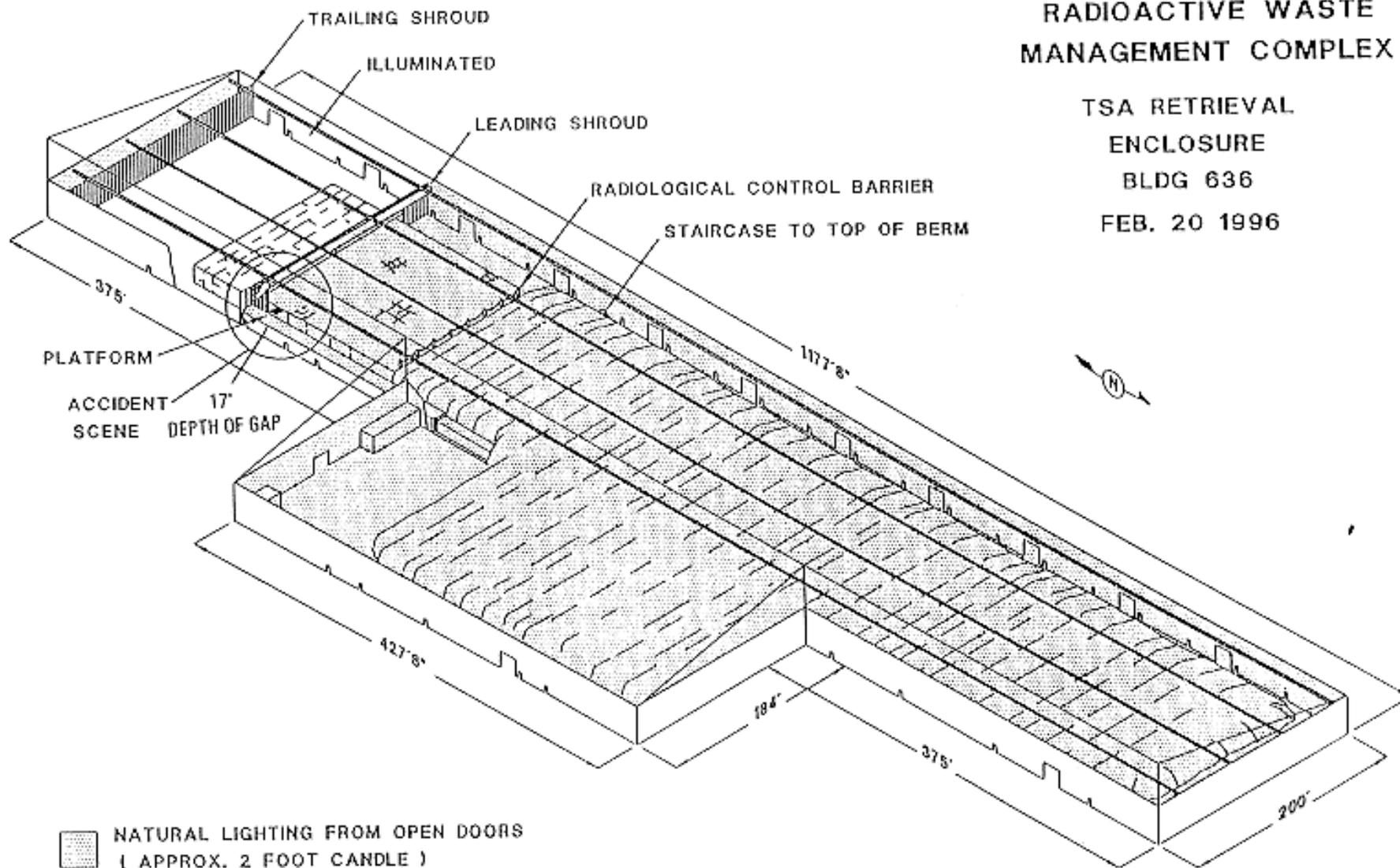


Exhibit 1-1. Transuranic Storage Area-Retrieval Enclosure

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The Board conducted its investigation, focusing on management systems at all levels, using the following **methodology**:

- Facts relevant to the accident were gathered.
- Relevant management systems and factors that could have contributed to the accident were evaluated in accordance with the Guiding Principles of Safety Management² identified by the Secretary of Energy in an October 1994 letter to the Defense Nuclear Facilities Safety Board, and subsequently to Congress.
- Event and causal factors charting,³ along with barrier analysis⁴ and change analysis,⁵ was used to provide supportive correlation and identification of the causes of the accident.

²Five guiding principles are identified in the Secretary's letter: line management responsibility for safety, comprehensive requirements, competence commensurate with responsibilities, independent oversight, and enforcement. The first three are applicable to management systems related to this investigation. The Secretary's letter included a comprehensive description of the functions that the Department deems necessary to fulfill its mandate under enabling legislation to provide "reasonable assurance that the safety and health risk of operating personnel and the public be minimized."

³Charting depicts the logical sequence of events and conditions (causal factors) that allowed the events to occur.

⁴Barrier analysis reviews hazards, the targets (people or objects) of the hazards, and the controls or barriers that management control systems put in place to separate the hazards from the targets. Barriers may be procedural, physical, or human.

⁵Change analysis is a systematic approach that examines failures in barriers and controls that result from planned or unplanned changes in a system.

2.0 FACTS AND ANALYSIS

2.1 ACCIDENT DESCRIPTION AND CHRONOLOGY

2.1.1 Background and Accident Description

The accident occurred at approximately 11:20 a.m. on Tuesday, February 20, 1996, at the TSA-RE, Building 636, when a construction subcontractor Project Engineer fell approximately 17 feet from a temporary platform. The Project Engineer was employed by Caddell Construction Company, Inc. (Caddell), a subcontractor of LITCO.

The project engineer fell off a temporary platform from a height of approximately 17 feet.

The TSA-RE is a 313,000 square foot facility whose purpose is to provide year-round storage and retrieval of mixed transuranic contaminated waste containers stacked on asphalt pads within the building. The facility is constructed over stacked boxes and drums containing radioactive waste. The stacked waste (stack) is covered by a vinyl-coated, geo-fabric tarpaulin (fabric) supplemented with plywood over some portions. Much of the northern portion of the stacked waste is covered by earth. The southern portion of the stack is covered by the fabric and is a radiologically controlled area delineated by a magenta and yellow chain emplaced across the stack at the point leading into the controlled area (see Exhibit 2-1). Two movable walls (shrouds) within the building define the work area in which the only ventilated portion of the building is located. The shrouds are positioned 200 feet apart at bulkheads built into the building. These bulkheads provide connections for power, lighting, breathing air, and ventilation.



No barriers were installed to keep workers away from the edge of the platform.

The scene of the accident was within the radiologically controlled



area on top of the box/drum radioactive waste stack on the southeastern portion of the stacked boxes. The area had uneven footing because of the way the boxes and drums were stacked under the fabric. There was a gap approximately 30 inches wide between the edge of the stacked boxes and the adjacent metal and cinder block facility wall. The 4 foot by 4 foot by 8 foot boxes were stacked four high, making the gap about 17 feet deep (see Exhibit 2-2). No barrier was installed to warn workers that they

were within six feet of an unprotected edge of the gap.

The platform was not intended to be a work platform without 100 percent fall protection.

The project engineer was escorting a vendor inspecting a crane.

A temporary platform (see Exhibit 2-3) had been installed in the area



of the accident scene by the ductwork subcontractor, Air-Con, Inc., for use in performing work on the transition piece for the exhaust air system. The platform was made of two 3/4 inch thick plywood sheets (4 feet by 8 feet) laid side by side and fastened to 2 inch by 12 inch wooden supports with screws. The outer 18 inches of the plywood sheets extended over the wooden supports (see Exhibit 2-4). The platform was intended to facilitate bolting of the transition piece and to keep parts from falling into the gap under the

The vendor heard the project engineer fall.



platform. It was not intended to be a work platform without 100 percent fall protection, and had no guardrails, toeboards, or other fall protection installed. The only lighting available in the area of the accident was ambient light from open rollup doors on the west side of the building. Illumination in the area of the platform was 2 foot-candles.

The TSA-RE is being constructed by Caddell, under subcontract to LITCO. Caddell uses subtier subcontractors to perform the actual construction work. The TC/American Monorail

Company provided the cranes that carry the shrouds and the ventilation ductwork. At the time of the accident, the Project Engineer was escorting a representative (Crane Vendor) of the TC/American Monorail Company. The Crane Vendor was inspecting the adjustments to the drive wheels of the crane supporting the leading shroud (a movable seal) across the fabric-covered portion of the stack. An ironworker, who was with the group, actually performed the adjustments. Acceptance testing of the crane was to begin on the afternoon of Wednesday, February 21, 1996.

The Project Engineer and Crane Vendor were on top of the waste stack in the building, starting from the west side, moving to the east, and observing the crane above them. The ironworker had gone to the other side of the shroud, and was not within view of the accident scene at the time of the accident. The Project Engineer and Crane Vendor were looking at the eastern-most drive wheel assembly of the crane. The Project Engineer passed to the east of the Crane Vendor's position to the edge of the stack and stepped onto the platform. At that point, the Crane Vendor was looking off to the side and up at the rest of the drive assembly. He heard the sound of scraping wood, looked toward the platform, and observed the Project Engineer in midair, falling into the gap between the stack and

The project engineer was taken to the regional medical center by helicopter and died from severe head and neck injuries.

the facility wall.

The Crane Vendor went to the edge of the stack, and, using a flashlight to look, saw the Project Engineer lying at the bottom of the gap (see Exhibit 2-5). The first lay responder arrived at the scene at 11:25 a.m. An emergency response request was made at the same time. The ambulance arrived at 11:32 a.m. and left with the Project Engineer at 11:38 a.m., arriving at the Central Facilities Area Medical Facility at 11:49 a.m. The Project Engineer was then transported by helicopter to the Eastern Idaho Regional Medical Center in Idaho Falls, Idaho, where he died at 4:10 p.m. from severe head and neck injuries.



2.1.2 Chronology of Events

Figure 2-1 summarizes the chronology of significant events.

2.1.3 Accident Response and Investigative Readiness

Response by site personnel from the inception of the incident through transport to medical treatment facilities in Idaho Falls was good. During the accident investigation, the following facts were noted regarding investigative readiness by LITCO and Caddell:

- Procedures for accident investigations did not address accident scene management or evidence handling, processing, preservation, and control. Nevertheless, timely personnel access controls to the accident scene were instituted, and scene configuration was maintained. Evidence control, accountability, and chain of custody were not effectively accomplished or timely. A composite record specifying the origin of the evidence, custodianship, and dates of transfer was not established by LITCO. In addition, the Project Engineer's personal effects and body were released before the Board arrived. No autopsy was performed, and no blood samples were taken prior to treatment.
- Provisions to support Type A and B accident investigations were not included in the LITCO subcontract with Caddell. As a result, the Board required the services of ID legal counsel and a LITCO contract administrator to obtain the Project Engineer's employment, work restriction, and medical records from Caddell. Further, the Project Engineer's employment-related medical records, fitness for duty report, and last medical examination were not furnished to the Board until nine days after the request was made.

Evidence presented to the Board by LITCO and Caddell consisted of the Project Engineer's personal protection equipment (hard hat and safety glasses), eyeglasses, and photographs of the accident scene. The personal effects were not available; they could have given insight into his medical condition at the time of the accident, and assisted in reconciling evidence presented to the Board. Evidence was collected and photographs were taken by various site personnel, stored at assorted locations, and provided to the Board over a 12-day period without accompanying chain of custody receipts. There were no procedures for these activities or for accident scene management. Photographs did not contain complete identification data (i.e., time, date, photographer's name) or a scale of reference to indicate the dimensions of the

Site response to the accident was good.

Contractor procedures were insufficient to perform or support all actions required for an accident investigation.

Some items of evidence that could have facilitated the investigation were unavailable or incomplete.



objects and distances in the photographs. The prolonged time that Caddell took to provide documentation necessary to the investigation indicates that Caddell was contractually unnecessarily reluctant in supporting the Board's requirements.

Although in this case an autopsy would not have affected the conclusions of the investigation (because the emergency medical treatment obscured the essential conditions), it is generally a good idea to conduct an autopsy for fatal accidents to confirm clinical diagnosis, or to identify contributory conditions or an unrecognized cause (e.g., head trauma vs. heart attack). If a blood sample had been taken prior to emergency medical treatment, it could have provided diagnostic information to assist the Board in determining the exact medical condition of the victim.

DOE Order 225.1 mandates that contractor requirement documents contain provisions for supporting Type A and B accident investigations and that contractor staff establish and maintain an accident investigation capability. Although the procedural deficiencies indicated above did not affect the ultimate outcome of the investigation, they did impact its efficiency.

The contractor's procedural deficiencies diminished the efficiency of the investigation, but did not affect its outcome.

2.2 PHYSICAL HAZARDS, CONTROLS, AND RELATED FACTORS

2.2.1 Medical Surveillance

The investigation revealed the following facts regarding the Caddell medical surveillance program:

- Caddell has a documented medical surveillance program that consists of annual comprehensive physical examinations, "fitness for duty" reports by the examining physician, designation of any resulting work restrictions, and execution of the work restriction(s) through the safety engineer, in conjunction with the employee's immediate supervisor.
- The medical surveillance program was referred to by Caddell staff interviewed during the investigation as a "wellness program."
- In the case of the Project Engineer, Caddell management received a work restriction report dated January 10, 1995, from a contracted occupation

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The subcontractor's medical surveillance program had issued work restrictions on the project engineer because he suffered from diabetes.

The project engineer knew of these restrictions, but his managers stated that they were not aware of them.

- Review of the occupational medical files of the Project Engineer revealed a fitness for duty report that contained restrictions against working alone, working at unprotected heights, and working around high speed machinery. The basis of the work restrictions was complications from long-term insulin-dependent diabetes.
- The Project Engineer was aware of these restrictions.
- The Caddell Project Manager (Project Engineer's supervisor) and the Caddell Safety Engineer stated they were not aware of the restrictions until after the accident. The letter containing the work restrictions was in the Caddell Safety Engineer's files.
- Not all applicable Caddell construction staff had annual medical evaluations. For example, one staff member is known to have a serious medical problem that has not been documented under the medical surveillance program during the 18 months he has been on site.

A comprehensive medical surveillance program for construction personnel that complies with 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response) consists of (1) an occupational work history evaluation completed by the employee, (2) an annual employee medical evaluation for members of the workforce, (3) medical diagnosis and analysis of disabilities or limitations considering the framework of the workplace, (4) reporting of recommended work restrictions to each employee and his/her supervisor, (5) implementation of work restrictions by the supervisor, and (6) recordkeeping.

The project engineer's failure to comply with the restrictions, and the subcontractor's failure to implement the medical surveillance program, contributed to the accident.

Caddell's medical surveillance program was not effective in communicating the work restrictions and enforcing compliance in this case. In addition, Caddell safety management did not exercise its responsibility to be aware of and execute work restrictions.

The Project Engineer's failure to execute his personal responsibilities under the program by abiding by the work restrictions was a contributing factor in the accident. The failure of Caddell to fully implement its medical surveillance program (poor communications of restrictions and insufficient enforcement of compliance with work restrictions) contributed to the accident, because non-compliance with the established program contributed to the Project Engineer's presence at the scene.

The project engineer had a reputation for safe work practices, but that day he failed to follow a number of procedures.

2.2.2 Personnel Performance

Facts relating to personnel performance at the time of the accident are:

- Interviews revealed that the Project Engineer had a reputation for safe work practices and for complying with applicable safety regulations.
- At the time of the accident, the Project Engineer was not wearing any fall protection equipment.
- To achieve entry into the area of the accident, the Project Engineer did not follow existing radiological control procedures; for example, he did not sign in and was not wearing a direct reading dosimeter at the time of the accident.
- The Project Engineer had a long history of serious diabetes and diabetic neuropathy.⁶
- The Caddell Project Manager had counseled the Project Engineer regarding his eating habits.
- A coworker and car pool rider stated that the Project Engineer normally ate an Egg McMuffin® and drank coffee en route to work each morning, but indicated that they did not stop and get food on the day of the accident. Examination of the Project Engineer's lunch box after the accident revealed an uneaten sandwich.

⁶Diabetic neuropathy is a slow, progressive loss of function of the sensory nerves in the limbs that causes numbness, tingling, and discomfort on both sides. It occurs after many years of diabetes, especially if the diabetes has not been controlled. The feet are often the first part of the body to be affected.

- The Project Engineer's personal diabetes specialist cited "unawareness of hypoglycemia"⁷ as a possible explanation for his uncharacteristic safety behavior on the day of the accident.
- The Crane Vendor and the ironworker were wearing fall protection equipment at the time of the accident.
- The Crane Vendor saw the Project Engineer walking toward the edge of the stack and then stepping onto the platform.
- Because the Crane Vendor was to be escorted in the construction area, he did not receive training in recognizing hazards and stop work authority.
- The Crane Vendor's attention was focused on the drive wheels of the crane above the stack area. When alerted by a "sound of scraping wood," he looked back at the platform and observed the Project Engineer falling.
- Both the Caddell Safety Engineer and the LITCO Safety Engineer stated that they had not previously inspected the platform from which the Project Engineer fell.

Caddell training records indicate that the Project Engineer was trained in the requirements of the Caddell ES&H Program Plan, which specifies the use of fall protection equipment for work at heights above six feet. Although Caddell's ES&H Program Plan identifies three progressive fall protection levels, in practice sole reliance was typically placed on the choice of last resort, which was the use of personal protective equipment and 100 percent tie-off.

His uncharacteristic failure to follow procedures may have resulted from impaired judgment and balance due to his medical condition.

Documentation and interviews did not indicate that Caddell or LITCO safety personnel were aware of the existence of the platform, and indicated that the Project Engineer was exhibiting uncharacteristic behavior on the day of the accident (i.e., entering into an obviously hazardous situation without the required fall protection equipment). Because of the Project Engineer's preexisting medical condition and evidence that he may have not eaten on the day of the accident, he may have unknowingly

⁷Hypoglycemia is a condition characterized by abnormally low blood sugar level. Some patients who require insulin become unaware of their hypoglycemia; that is, they can no longer recognize its symptoms and counterregulate it. When a patient is unaware of hypoglycemia, the blood sugar concentration continues to decrease and must reach a very low level before the patient experiences symptoms such as headache, uncoordination, double vision, inappropriate behavior, and confusion.

suffered a hypoglycemic event that may have affected his judgment. Also, the diabetic neuropathy in his feet and legs could have affected his ability to maintain his balance. Thus, it appears likely that his medical condition may have contributed to his fall, and impaired judgment may have contributed to the accident.

2.2.3 Management Systems

2.2.3.1 Policies and Procedures

- Caddell is the subcontractor responsible for the construction of the TSA-RE.
- The original TSA-RE construction subcontract with Caddell was awarded in September 1993, through the INEL Construction Manager, MK Ferguson of Idaho Company (MK-Ferguson).
- The Caddell subcontract was assigned to LITCO in October 1994, during the INEL M&O contract transition.
- Safety requirements imposed in the subcontract with Caddell were contractually passed down to subtier subcontractors through Caddell.

Review of the contract articles and the MK-Ferguson subcontract documents incorporated in the TSA-RE construction contract confirm that clear and appropriate safety policy and standards exist in the subcontract awarded to Caddell. Specifically, comprehensive construction safety requirements addressing full coverage for scaffolding and fall protection, including use of personal protective equipment, are clearly delineated and contractually incorporated from the OSHA standards (29 CFR 1910 and 1926) through

The subcontractor was contractually required to implement Departmental safety policies and standards, including requirements for fall protection and medical surveillance.

applicable DOE orders, the MK-Ferguson construction management contract documents, the Caddell construction subcontract, and subtier subcontracts awarded by Caddell.

Caddell, as required by its subcontract, submitted its ES&H Program Plan for RWMC in November 1993, for review and acceptance by MK-Ferguson prior to start of work. The Caddell ES&H Program Plan adequately reflects INEL safety policy and OSHA standards invoked by DOE orders.

Explicitly incorporated in Caddell's subcontract (Special Condition Clause 17 "Construction Health and Safety," paragraph A, Attachment 7 and the MK-Ferguson Site Health and Safety Plan) is the requirement for 100 percent fall protection. This fall protection policy duplicates the tiered approach defined in the OSHA standards using (1) engineered barriers, (2) administrative restraints and signs, and (3) personal protective equipment. This fall protection policy was contractually passed down to Caddell, and subsequently through Caddell to its subtier subcontractors, and was clearly reflected in Caddell's ES&H Program Plan for the RWMC which was accepted by MK-Ferguson.

Furthermore, Special Conditions Clause 17, Paragraphs E and I (the latter invoking the MK-Ferguson "INEL Safety Work Control Procedures," WCP S-5 "Scaffolding," and WCP S-6 "Job Safety Analysis Plan") require submission of a plan for scaffolding and job safety analysis for the TSA-RE project. These safety submittals were provided by Caddell and its subtier subcontractors during the project.

Special Condition Clause 17 (Construction Health and Safety) of Caddell's subcontract, Paragraph J (Site Health and Safety Plan), invokes a medical surveillance program requiring Caddell and its subtier subcontractors to implement a program for all personnel "involved in onsite execution of construction activities." Diabetes is noted as one of the special medical conditions that must be reported to the safety engineer and supervisory personnel.

The subcontractor failed to follow Departmental requirements and its own procedures pertaining to hazards analysis.

2.2.3.2 Work Planning and Controls

Hazards Analysis

Facts relating to hazards analysis are as follows:

- Interviews revealed that neither a Job Safety Analysis nor a Construction Safe Work Permit (ID-F-5480.1H),⁸ as required by the Caddell ES&H Program Plan and DOE Order 5480.9A, was

completed and implemented for the transition piece installation and platform construction.

⁸DOE Order 5480.9A, *Construction Project Safety and Health Management*, now refers to these analyses as a Preliminary Hazards Analysis and an Activity Hazard Analysis, respectively.

- Interviews with ID, LITCO, and Caddell line management and safety personnel revealed that the radiological control barrier discouraged personnel from inspecting the stack area for hazards. Thus, they did not approach near enough to adequately see, in the existing lighting conditions, the edges of the stack or the platform. They were therefore unable to recognize the safety deficiencies.

Failure to follow existing procedures for completing the required Job Safety Analysis or a Construction Safe Work Permit led to conditions in which hazards were not identified and were left unmitigated prior to the accident.

A Job Safety Analysis or Construction Safe Work Permit is required to identify specific hazards and appropriate control measures. The Job Safety Analysis need not be complex, but must specify, in advance, the actual work practices and protective measures to be implemented. This practice mitigates potential impacts to safety and health, project cost, and schedule. Further, the Job Safety Analysis includes the timely planning of abatement strategies for imminent danger situations. Alternatively, a Construction Safe Work Permit may be completed. It provides a detailed job description, including the erection of any temporary structures, and informs workers and supervisors of the hazards and protective measures in effect in areas requiring performance of hazardous tasks.

Meeting the requirement for completing a Job Safety Analysis or a Construction Safe Work Permit for the transition piece installation and the platform would have identified specific safety hazards and mitigation strategies, such as the required safety measures and warnings on or near platform. Following these procedures would have reduced the platform's potential as an attractive nuisance.

ID, LITCO, and Caddell safety and line management personnel expressed the view that the principles of As Low As Reasonably Achievable for radiological protection precluded direct inspection of

The radiological control barrier discouraged safety personnel from entering the area to inspect for hazards, and the light was too dim to allow them to see the hazards from outside the area.

the area in which the platform was located. Consequently, these inspections were conducted only from outside the radiological control barrier. Although the principles of As Low As Reasonably Achievable apply, they should not be interpreted as precluding the necessity for such inspections. The lighting conditions also contributed to the inability to make an accurate and timely assessment of the safety hazards in the area of the stack from the radiological control barrier. Thus, the platform or other hazards on the stack were never identified.

Physical Barriers

On the day of the accident:

- There were no general barriers, warning lines, or signs to alert personnel on top of the stacks to the fall hazards in the area. There were no other safety barriers for the platform.
- The platform was intended to catch falling tools or parts and provide support for the transition ventilation piece, but it was also used as a work platform for personnel with 100 percent fall protection.
- There were no static lines or designated (i.e., engineered) anchor points for personnel to connect fall protection equipment in the vicinity of the platform.
- Lighting in the area of the platform was measured at 2 foot-candles.

Occupational Safety and Health Standards for the Construction Industry (29 CFR 1926) require that, when working from an area greater than six feet in height or near unprotected edges or sides, personal protection in the form of a fall protection system be in place during all stages of active work. Violations of fall protection requirements usually constitute an imminent danger situation. Lighting in the area was less than the minimum of 5 foot-candles prescribed by the OSHA standards (29 CFR 1926.56). This level of illumination may have contributed to the accident, taking into consideration the visual adjustment when moving from a brighter area to a progressively darker area, as was the case in the area where the accident occurred. There were no permanently installed fall protection systems, barriers, or warnings; each subcontractor was expected to identify the fall hazards and provide its own fall protection system as they saw fit. The combination of these circumstances was a contributory cause to the accident.

There were no permanent fall protection systems in the area of the accident, and there were no safety barriers or warnings to keep people away from the edge of the stacks.

The combination of insufficient barriers, warning lines or signs, fall protection, and illumination was a contributory cause to the accident.

The contractor had repeatedly directed the subcontractor to improve safety performance, and had taken steps to enforce safety compliance.

2.2.3.3 Supervision, Management, and Oversight

- Review of project records revealed a general theme of significant, ongoing concern and a need for corrective actions expressed by LITCO management regarding Caddell's safety performance at the TSA-RE.
- LITCO used a series of progressive steps to apply increasing pressure and furnish guidance to Caddell in an effort to improve construction safety at the TSA-RE project, up to and including directing removal of the Caddell Project Superintendent for failure to execute safety policies in the field.
- LITCO consistently rated the safety performance of Caddell as poor to weak and consequently withheld the maximum allowable (10 percent) progress payments to encourage safety performance improvement.
- "Signs and Barricades" and "Fall Protection" accounted for over 20 percent of the noted safety deficiencies through October 1995.
- Interviews with LITCO management indicated that in August 1995, LITCO considered terminating Caddell's subcontract on the grounds of inadequate safety performance.
- The project record shows an effort by LITCO to assist Caddell in improving its safety program. For example, LITCO offered topics and material for safety toolbox meetings and established an incentive program to reward safe workers.
- Despite Caddell's across-the-board contractual responsibility for safety, LITCO observed an apparent reluctance on the part of Caddell to enforce 100 percent safety compliance in construction subtier contractors. At times, LITCO found it necessary to bypass Caddell and work directly with subtier construction craft personnel to highlight safety deficiencies and ensure appropriate resolutions in the field.
- ID line management responsibility for the TSA-RE project flows from the Operations Office Manager through the Assistant Manager, Office of Program Execution, to the RWMC Facility Manager. The RWMC Business Management Plan describes clear safety roles and responsibilities for ID.
- Numerous surveillances and walkdowns of the TSA-RE by facility management and other ID personnel identified instances of poor

The subcontractor's poor safety record is well known to

housekeeping, electrical safety deficiencies, fall protection deficiencies, and inadequate barriers and postings.

the contractor and the Operations Office.

- ID line management conducts monthly performance monitor meetings with LITCO to communicate performance deficiencies. Deficiencies in the safety performance of Caddell and Caddell's subcontractors were a routine topic at these meetings. Poor safety performance on the TSA-RE was noted in the LITCO award fee evaluation for the period ending September 30, 1995.
- The Office of Environmental Management (EM-30) has line management responsibility for the TSA-RE project.
- EH conducted an independent Safety Management Evaluation of ES&H programs at INEL during the period of June through August 1995. This evaluation noted safety performance problems with the TSA-RE project and stated that, "There are a number of indications that the TSA-RE subcontractor did not embrace safety management to the same degree as ID, [LITCO], and other [LITCO] subcontractors." The report concluded that both LITCO and ID had recognized the problems and were taking actions, but that current contracts may have to be examined to ensure that subcontractor line management can be held accountable for safety performance.
- An EH resident conducted a surveillance and walkdown of the TSA-RE in August 1995. He was aware of the deficiencies being noted and the actions being taken by ID and LITCO.

Numerous evaluations have noted deficiencies in implementation and execution of requirements.

While some deficiencies in documentation, policy, and procedures were noted, Caddell's major shortcoming has been inadequate implementation and field execution of requirements described in its ES&H Program Plan and procedures. Important examples, directly pertinent to this investigation, are:

- Overreliance on 100 percent tie-off for fall protection, rather than the three-tiered approach described in their documentation
- Failure to enforce the 100 percent tie-off requirements
- Failure to implement the requirements of the medical surveillance program.

The Board encountered numerous other indications of Caddell management's attitude toward safety. A recent example is a Caddell corporate office letter of February 5, 1996, denouncing LITCO's order to replace the Project Superintendent and characterizing

LITCO's approach to safety as "heavy handed." Caddell's deficient safety program implementation is contributory to the conditions that led to the accident.

The Board examined the adequacy and timeliness of LITCO's actions to influence Caddell's behavior. Given the long record of correspondence with Caddell based on deficiencies observed in the field, the increasing severity of actions taken, and the perceptions by most people interviewed that the actions were resulting in improvement, LITCO's actions were generally adequate. However, four significant deficiencies were noted in LITCO oversight:

- Failure to recognize that warning signs and barriers were not in place in the work area on top of the stacked boxes
- Failure to recognize that Caddell's reliance on 100 percent tie-offs was not in accordance with its ES&H Program Plan
- Failure to recognize that Caddell was not executing its contractual requirements for an effective medical surveillance program
- Failure to quickly assess and correct deficiencies that require immediate action in light of their seriousness (i.e., imminent danger situations) in a systematic manner, while simultaneously using progressive means to deal with Caddell's overall contractual performance.

Roles, responsibilities, and authorities within ID are clearly defined and understood. The RWMC Facility Manager used performance indicators and trends effectively to highlight areas of contractor performance requiring improvement. These areas received increased oversight, and deficiencies were frequently communicated to LITCO. Pressure exerted by ID to correct deficiencies in Caddell's safety program was resulting in improved performance. The award fee process and incentives negotiated with LITCO in the area of ES&H are focusing LITCO's attention on improved performance in this area. However, ID oversight did not recognize that LITCO was not assessing Caddell's compliance with all contractual ES&H obligations, and therefore the medical surveillance program deficiencies went undetected. ID oversight focused heavily on performance in the field and generally did not assess how well LITCO was doing in overseeing other aspects of the Caddell contract.

There are no issues relative to oversight by EM that have a bearing on this accident.

The prime contractor's actions were generally adequate.

Operations Office oversight focused more on field performance than on the compliance issues that pertain to this accident.

There are no issues of technical competence that have a bearing on this accident.

2.3 BARRIER ANALYSIS

A barrier analysis was performed that identified three types of barriers germane to the accident: (a) administrative controls, (b) physical barriers, and (c) management barriers. Successful performance by any of these types of barriers would have prevented the accident. The barriers that failed are summarized in Figure 2-2. Appendix B provides the details of this analysis.

Barriers that failed or were not used were industrial safety postings and fall protection requirements. The safety and health plans and fall protection procedures identified a hierarchy of actions to be taken, with personal protective equipment as a last resort. These procedures were not followed because of the work activity level in the area, the radiological posting, the low lighting levels, and the strong emphasis on 100 percent tie-off for fall protection.

Furthermore, a Job Safety Analysis or Construction Safe Work Permit was not completed to specifically address the temporary platform from which the Project Engineer fell, and construction management was not aware that the platform was left in place. Controls were not in place to keep the platform from being improperly used as a work surface. Additionally, safety surveillance was not increased in the area as work activity levels increased, since individuals believed that they could see enough of the area to assess any safety hazards without crossing the radiological control barrier. However, lighting was below standards for work activities at the accident scene, and the platform was not clearly visible from the radiological control barrier.

Occupational medical program requirements were not emphasized, so medical information on individual employees was not being used by Caddell management, and work restrictions were not enforced. The Project Engineer had work restrictions against working at unprotected heights, working alone, and working around high speed machinery. In addition, his Fitness for Duty Form indicated that "hearing protection was required." The Crane Vendor was being escorted by the Project Engineer at the

Successful performance of administrative, physical, and management barriers would have prevented the accident.

time of the accident, and was always escorted in the construction area. Therefore, he was not trained in stop work authority, and did not stop the Project Engineer from approaching the elevated edge of the stack and the platform.

2.4 CHANGE ANALYSIS

A change analysis was performed to determine points where changes are needed to correct deficiencies in the safety management system and to pinpoint changes and differences that may have had an effect on the accident. The results of the analysis are in Appendix C.

Changes directly contributing to the accident were failure to execute established procedures for fall protection, signs and barricades, and Job Safety Analysis/Construction Safe Work Permit; unsafe use of the temporary platform; insufficient lighting in the platform area; and unenforced work restrictions for the Project Engineer. No Job Safety Analysis and/or Construction Safe Work Permit was performed on the platform, leading to a failure in the hazard analysis process and unidentified and uncorrected hazards. Deficiencies in the medical surveillance program and failure to enforce work restrictions allowed the seriously diabetic Project Engineer to be present on the platform. Deficiencies in the management of the safety program within Caddell are also related to failures in the medical surveillance program.

Changes brought about by Caddell management failures resulted in a deficient worker safety program. Caddell management failed to implement the contractual safety requirements necessary to prevent the accident and avoid deficiencies in the worker safety program.

LITCO's progressive approach to improving Caddell's compliance with safety requirements was successful to a degree, but failed to prevent recurrence of imminent danger situations.

2.5 PROBABLE CAUSAL FACTORS

Figure 2-3 depicts the logical sequence of the events and causal factors for the accident. It indicates, in a time-sequenced flow, factors that allowed the accident to occur.

The **direct cause** of the accident was the fall from an unprotected platform. However, there were also **contributing causes** (causes that, if corrected, would not, by themselves, have prevented the accident but are important enough to be recognized as needing corrective action) and **root causes** (the fundamental causes that, if

Changes resulting from failure to follow procedures directly contributed to the accident.

The prime contractor's approach to improving subcontractor safety performance did not address imminent danger situations.

corrected, would prevent recurrence of this and similar occurrences). Causal factors are identified on Table 2-1, with a short discussion of each cause.

Contributing causes for the accident were:

- Failure to implement or disregard for safety procedures in effect at the time of the accident
- Insufficient emphasis on safety by Caddell management
- Insufficient illumination in the area of the temporary platform
- Failure to remove the temporary platform
- Absence of warning signs and barricades
- Incomplete oversight by LITCO and ID (failure to identify Caddell's non-compliance with the medical surveillance program, protective measures for imminent danger situations, and other safety procedures).

Other possible contributing factors were the impaired judgment and physical condition of the Project Engineer. These causes could not be substantiated.

Root causes of the accident were:

- **Failure by Caddell to implement requirements and procedures that would have mitigated the hazards.** The implementation of comprehensive and appropriate requirements is the second of DOE's safety management principles. Caddell failed to implement its medical surveillance program and to enforce work restrictions for the

Direct, contributing, and root causes for the accident were identified.

Failures by the subcontractor to follow two of the Department's guiding principles of safety management were the root causes of the accident.

Table 2-1 CAUSAL FACTOR ANALYSIS

ROOT CAUSES	DISCUSSION
Management Responsibilities	Caddell management failed to implement contractual requirements for responsibility and accountability for contractor safety programs.
Safety Requirements Implementation	<p>Caddell management failed to implement requirements of the medical surveillance program and implement personnel work restrictions; failed to implement safety policy into an effective worker safety program (Job Safety Analysis, fall protection, signs and barricades).</p> <p>Caddell failed to identify the requirements for a Job Safety Analysis for the temporary platform. As a result, there was a hazard analysis process failure associated with platform use that was not identified, and appropriate safety counter-measures (fall protection, signs and barricades) that were not implemented.</p>
CONTRIBUTING CAUSES	DISCUSSION
Procedures	Procedures in effect at the time of the accident (fall protection, signs and barricades, medical surveillance, Job Safety Analysis) were disregarded. The successful application of these procedures could have prevented the accident.
Oversight	Assessments by ID and LITCO did not reveal the failure of Caddell management to enforce the medical surveillance program and implement work restrictions.
Supervision	The Caddell Project Superintendent failed to implement safety responsibilities for the safety programs. This contributed to deficiencies in worker safety program.
Illumination	The area at the temporary platform had low lighting levels (2 foot-candles) which may have caused visibility problems around the platform.
Platform	The platform was left in place when work was completed, creating an attractive nuisance. Safety measures for such a platform should have included toeboards, guardrails, and support for platform edges or signs and barricades.
Signs and Barricades	The absence of signs and barricades at the elevated edges of the stack contributed to the accident.

Project Engineer. A hazards analysis, required by DOE Order 5480.9A and the Caddell ES&H Program Plan, was not conducted; consequently, the hazards associated with the platform were not identified, and no countermeasures were implemented. The absence of fall protection, physical barriers, and warning signs in the vicinity of the platform, along with inadequate lighting, violated DOE requirements that invoke Federal safety standards. Furthermore, the contractual requirements for safety, as prescribed in Caddell's ES&H Program Plan and the subcontract with LITCO, were not implemented. Finally, failure to ensure that comprehensive requirements are fully implemented represents a fundamental flaw in the safety management program of Caddell and exhibits failure to meet the management requisites for the second of DOE's safety management principle's requiring that comprehensive and appropriate requirements be established and effectively implemented to counteract hazards and assure safety.

- **Failure by Caddell to implement the principle of line management responsibility and accountability for safety.** Line management responsibility and accountability for safety is the first of DOE's safety management principles. Caddell has clear safety policies and well-defined responsibilities and authorities for safety. However, Caddell line management has failed to appropriately analyze and manage hazard mitigation and, when faced with adverse consequences for poor safety performance, has refused to accept accountability. Caddell consistently failed to implement effective safety policies and practices as reflected in DOE, ID, and LITCO policies and industry standards. In addition, Caddell failed to foster a safe work attitude throughout its organization and in its lower tier subcontractors. Caddell did not meet contractual requirements for safety and its own safety policy. The result has been routine use of poor safety practices by both Caddell and its subtier subcontractors, reflected in Caddell's poor safety performance record. Finally, Caddell failed to ensure that findings resulting from reviews, monitoring activities, and audits were resolved in a timely manner. Caddell's approach and numerous safety program failures reflect less than full commitment to safety and directly led to the accident.

3.0 CONCLUSIONS AND JUDGMENTS OF NEED

This section of the report identifies the conclusions and judgments of need determined by the Board, as a result of using the accident analysis methods described in Section 2.0. Conclusions of the Board consider significant facts and pertinent analytical results. Judgments of need are managerial controls and safety measures believed necessary to prevent or mitigate the probability or severity of a recurrence. They flow from the conclusions and causal factors and are directed at guiding managers in developing follow-up actions. The final four judgments of need address potential policy requirements in the accident investigation process, while the remainder focus on causal factors. Table 3-1 identifies the conclusions and the corresponding judgments of need identified by the Board.

Table 3-1 Conclusions and Judgments of Need

CONCLUSIONS	JUDGMENTS OF NEED
<ul style="list-style-type: none"> ■ Comprehensive safety requirements exist, are contractually invoked, and are appropriate for the nature of TSA-RE construction work. 	None
<ul style="list-style-type: none"> ■ Caddell failed to follow procedures required by its contract and by its ES&H Program Plan, including: <ul style="list-style-type: none"> • Caddell failed to adequately implement a medical surveillance program, thereby permitting an individual with medical restrictions, including not working at heights, to work in violation of those restrictions. • The Project Engineer had several medical restrictions, including not working alone, not working at heights, and not working around high speed machinery. • Caddell failed to adequately implement fall protection requirements contained in its ES&H Program Plan for the TSA-RE project, including enforcement of a three-tiered approach to fall protection. The third tier (choice of last resort) requires anchor points, lanyards, shock absorbers, and full-body harness. 	Caddell line management and safety personnel need to implement existing safety requirements and procedures, including the full requirements of the medical surveillance program.

Table 3-1 Conclusions and Judgments of Need (continued)

CONCLUSIONS	JUDGMENTS OF NEED
<ul style="list-style-type: none"> • Although the Project Engineer had a reputation for adhering to applicable safety regulations, on the day of the accident, he did not follow prescribed procedures. He was not wearing any fall protection equipment and did not obtain a direct reading dosimeter before entering the radiological control area. • The Project Engineer’s preexisting medical condition, which was the source of his medical restrictions, may have impaired his judgment and may have contributed to the accident. 	
<ul style="list-style-type: none"> ■ Caddell and LITCO did not fully implement the hazard inspection requirements of the TSA-RE contract and Caddell’s ES&H Program Plan, and therefore did not sufficiently identify or analyze hazards and institute protective measures necessary due to changing conditions. • A radiological control barrier discouraged access to the area, and made it difficult for line management and safety personnel to recognize and analyze safety hazards in the surrounding area, including hazards associated with the platform. • Neither a Job Safety Analysis nor a Construction Safe Work Permit was completed for the transition piece installation and temporary platform construction in accordance with contractual requirements. • Caddell management at all levels, including the corporate office, was unresponsive to demands for improved safety performance for a significant portion of the construction project. • LITCO failed to assess Caddell’s compliance with all contractual ES&H obligations and thus did not recognize that the medical surveillance and fall protection programs were not being executed as described in the Caddell ES&H Program Plan. • Idaho Operations Office oversight focused almost exclusively on the performance of Caddell and its subtiers in the field. As a result, the Operations Office failed to recognize that LITCO was not assessing all aspects of Caddell’s ES&H contractual obligations. 	<p>There is a need for Caddell and LITCO to ensure than an adequate hazards analysis is performed prior to changes in work tasks that affect the safety and health of personnel.</p> <p>LITCO needs to carefully evaluate, post, and control radiological control boundaries so that access to areas for safety and management walkdowns is not discouraged, or access made unnecessarily restrictive.</p> <p>LITCO and Idaho Operations Office oversight programs need to be better balanced between field verifications and assessments of all aspects of Caddell’s ES&H program.</p>

Table 3-1 Conclusions and Judgments of Need (continued)

CONCLUSIONS	JUDGMENTS OF NEED
<ul style="list-style-type: none"> ■ A temporary platform, used as a work surface for personnel activities when employing 100 percent fall protection, did not have guardrails and was left in place without barriers or other warning devices. <ul style="list-style-type: none"> • Caddell failed to post adequate warning signs and establish barriers on the stack to warn personnel that they were approaching within six feet of the edge of a fall hazard, as required by Occupational Safety and Health Administration regulations and Caddell's ES&H Program Plan. • LITCO failed to recognize that warning signs and barriers were not in place in the work area on top of the stack. 	<p>Caddell and LITCO need to ensure that safety personnel inspect changing work conditions for previously unidentified safety and health hazards, and implement protective measures.</p>
<ul style="list-style-type: none"> ■ Although response by site personnel to the accident was good, Caddell's and LITCO's actions in the wake of the accident demonstrated little understanding of investigative readiness capabilities. <ul style="list-style-type: none"> • Caddell failed to provide the Board, in a timely manner, the Project Engineer's employment, work restrictions, and medical records. Caddell also failed to recognize the Board's investigative needs before releasing the Project Engineer's personal effects. • LITCO failed to develop an accident investigation readiness capability addressing evidence preservation, control, accountability, and chain of custody. 	<p>ID needs to develop contractual requirements and modify existing contractual requirements for accident investigation readiness capability to ensure timely responsiveness to the needs of future investigations, in accordance with DOE Order 225.1.</p>
<ul style="list-style-type: none"> ■ The Board was unable to determine the exact medical condition of the Project Engineer at the time of the accident, since a blood sample was not obtained prior to administering treatment, nor was an autopsy performed. 	<p>There is a need for the Assistant Secretary for Environment, Safety and Health to consider a policy for taking blood samples before intravenous solutions are administered in serious accident situations that occur on DOE property.</p> <p>There is a need for the Office of General Counsel to develop a Departmental policy for performing autopsies on fatal accident victims when the accident occurs on DOE property.</p> <p>There is a need for the Office of General Counsel to determine whether a policy is needed for "impounding" any personal property and contractor records (i.e., medical) of accident victims, until the Accident Investigation Board has had an opportunity to review their relevance to the circumstances of the accident.</p>

4.0 BOARD SIGNATURES

Oliver D. T. Lynch, Jr., Board Chairperson
DOE Trained Accident Investigation Board Chairperson
U.S. Department of Energy, EH-24

Date _____

Eva Jean Bryson, Board Member
DOE Trained Accident Investigator
U.S. Department of Energy, Rocky Flats

Date _____

James S. Campbell, Board Member
DOE Trained Accident Investigator
U.S. Department of Energy, Oak Ridge

Date _____

Jay C. Greenberg, Board Member
OSHA Trained Accident Investigator
U. S. Department of Energy, Idaho

Date _____

Donald E. Shadley, Board Member
DOE Trained Accident Investigator
U. S. Department of Energy, Idaho

Date _____

Robert Stallman, Board Member
U. S. Department of Energy, Idaho

Date _____

5.0 BOARD MEMBERS, ADVISORS AND STAFF

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Member	James S. Campbell, DOE-Oak Ridge
Member	Eva Jean Bryson, DOE-Rocky Flats
Member	Jay C. Greenberg, DOE-Idaho
Member	Donald E. Shadley, DOE-Idaho
Member	Robert Stallman, DOE-Idaho
Advisor	Leonard M. Lojek, DOE (EH-23)
Advisor	Dennis Vernon, DOE (EH-21)
Advisor	Virginia M. Johnson, DOE (EH-21)
Advisor	Brian G. Edgerton, DOE-Idaho
Advisor	William C. McQuiston, DOE-Idaho
Advisor	David R. Spence, Consultant
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Appendix B. PERFORMANCE OF BARRIERS

Barrier	Purpose	Performance
Fall Protection Caddell ES&H Plan, p19 Contract General Conditions (GC-7) p25	To standardize the applications of fall protection and outline responsibilities for its safe conduct and use.	Barrier failed because the plan was not followed.
Signs and Barricades Procedure 29 CFR 1926.200	To standardize the application of signs and barricades in hazardous situations and outline responsibilities for their use.	Barrier failed because the plan was not used and signs and barricades were not installed at the platform or on the stacked boxes 6 feet from the edge.
Platform Construction Requirements 29 CFR 1926.501(a)(2) 29 CFR 1926.501(b)(1)	To specify the requirements for structural stability and fall protection requirements for platform.	Barrier failed because the temporary platform was left in place and became an attractive nuisance. The edges of the platform were unsupported, toeboards, guardrails, and anchorage points were not installed.
Job Safety Analysis Caddell ES&H Plan, p17-19 Contract General Conditions (GC-7) p16	To identify the hazards associated with use of the platforms and work at heights and the safety measures required to offset the hazards.	Barrier failed because Job Safety Analysis was not performed and hazards were not addressed for temporary platform at this location or within six feet of edge of stack.
Illumination	To provide sufficient lighting for the safe accomplishment of work and surveillance/ inspection activities in a construction area.	Barrier was defeated because lighting in the work area was 2 foot-candles, a level below the required minimum of 5 foot-candles.

Appendix B. PERFORMANCE BARRIERS (Cont'd.)

Barrier	Purpose	Performance
Medical surveillance	To determine the ability of personnel to perform their duties considering the physical condition and health.	This barrier failed because Caddell Management failed to implement the requirements of their Medical Surveillance Program.
Work restrictions: no work alone, at unprotected heights or operate high-speed machinery	To specify restrictions to be applied for the Project Engineer's work activities because of health conditions.	Barrier failed because work restrictions were not implemented by management for a period of 13 months in determining safe work activities for Project Engineer.
Individual judgment	Individual judgment should identify hazardous situations prior to imminent danger.	This barrier failed because the Project Engineer's judgment may have been impaired by a hypoglycemic event.
Caddell management approach toward safety	"ES&H will be given primary importance in planning and operating company activities in order to protect employees against occupational injuries and illness." (Caddell ES&H Plan).	Barrier failed because Caddell management failed to implement their ES&H Program Plan; did not require a review of all issues during safety engineer turnover; did not react to correct unsafe occurrences; and did not exercise its safety responsibilities.

Appendix C. CHANGE ANALYSIS

Change or Difference		Analysis	
Planned/Normal	Present	Difference	Analysis
<p>Fall protection procedure requires 100 percent tie-offs and anchorage past six feet from edge.</p> <p>Signs and barricades procedure requires obstructions to deter the passage of personnel and signs warning of hazards at required locations.</p> <p>Personnel are able to maintain normal balance and imbalance recovery.</p>	<p>Fall protection procedure disregarded by Project Engineer.</p> <p>Signs and barricades procedures disregarded by Caddell/Air-Con, Inc., personnel when they left the platform in place.</p> <p>Project Engineer was unable to recover balance.</p>	<p>Fall protection harness was not used by Project Engineer.</p> <p>Barriers and warning signs not in place near platform and edge of boxes to warn personnel.</p> <p>Project Engineer's diabetic neuropathy may have impaired his ability to maintain or recover his balance.</p>	<p>Failure to follow fall procedures contributed to fatality.</p> <p>Compliance with this procedure may have prevented fatal accident.</p> <p>Project Engineer had impaired sensory functions in lower extremities possibly due to diabetic neuropathy.</p>

Appendix C. CHANGE ANALYSIS (Cont'd.)

Change or Difference		Analysis	
Planned/Normal	Present	Difference	Analysis
<p>Project Engineer's characteristic behavior was role model of safety consciousness.</p>	<p>Project Engineer walked without hesitation and without fall protection into a clearly dangerous situation. He also failed to use access and radiological control protocol.</p>	<p>Uncharacteristic behavior for this Project Engineer.</p>	<p>Being unaware of hypoglycemic condition may be a factor in this situation since this condition may alter judgment, balance, and vision.</p>
<p>Personnel are able to judge hazardous work conditions and avoid them or wear protective equipment.</p>	<p>Project Engineer may not have been able to judge hazards present near platform.</p>	<p>Project Engineer approached to within 6 feet of the elevated edge and stepped onto platform without fall protection.</p>	<p>Potential hypoglycemic condition may have impaired judgment. In addition, because of advanced diabetic condition, the Project Engineer may have lost the ability to detect the onset of hypoglycemic events.</p>

Appendix C. CHANGE ANALYSIS (Cont'd.)

Change or Difference		Analysis	
Planned/Normal	Present	Difference	Analysis
Temporary platforms required to have fall protection provided along with warning signs and barriers.	Air-Con, Inc. personnel had 100 percent fall protection when platform was in use. Static lines, warning signs, and barriers were removed, but platform was left in place.	Air-Con, Inc., temporary platform was left in place following completion of specific items of work with no warning signs and barriers.	Unsafe conditions at platform resulted in Project Engineer fatal fall.
Job Safety Analysis and/or Construction Safe Work Permit required for each work package.	Job Safety Analysis and/or Construction Safe Work Permit not performed for temporary platform .	Platform hazards were not identified, safety provisions for platform not provided.	Failure to identify hazards and provide safety measures contributed to the accident.
Temporary lighting by Air-Con, Inc., for work activities at platform.	Temporary lighting was not provided for Project Engineer and Crane Vendor drive wheel inspections.	Project Engineer may not have had sufficient lighting to identify the hazards associated with platform.	Lighting may have contributed to the accident.
Medical surveillance program must provide for identification of fitness for duty issues and enforce work restrictions.	Caddell medical surveillance program identified Project Engineer general health conditions and work restrictions.	Project Engineer work restrictions were not enforced.	Deficiencies in medical surveillance and failure to enforce work restrictions contributed to the accident.

Appendix C. CHANGE ANALYSIS (Cont'd.)

Change or Difference		Analysis	
Planned/Normal	Present	Difference	Analysis
Subcontractor management must accept accountability and responsibility for subtier safety.	Caddell management failed to execute contractual requirements for the safety program.	Caddell did not implement requirements of worker safety program.	Caddell management's failure to implement contractual safety requirements contributed to the accident.
Progressively severe penalties for violation of safety requirements should provide rapid response to corrections.	LITCO steps up severity of penalties as Caddell fails to respond to contractual requirements.	Caddell fails to enforce requirements in worker safety program.	Led to gradual improvements in worker safety program, but failed to prevent recurring imminent danger situations.